Soil Texture

How the size of particles in soil affect its properties



Soil Texture relates to the "feel" of a moist soil when it is manipulated between thumb and forefinger and depends on the relative amounts of sand, silt and clay particles in a soil. Some soils are sticky, others will not stick together at all, some feel "doughy" or "spongey" and other soils can be manipulated like plasticine. Soil texture affects the movement and availability of air, nutrients and water in a soil and is often used to estimate other soil properties, particularly soil water properties.

The effect of particle size

In soils, sand, silt and clay are defined by the size of the grains and not by their composition, colour or consistence. Sand particles range from 2 mm to 0.06 mm in diameter and are the grains visible to the naked eye. Silt particles range from 0.06 to 0.002 mm in diameter and clay particles are less than 0.002 mm in diameter. Soil contains particles of all sizes and the proportion of each size grade determines its texture. The relative size of particles is important as the surface area of a spherical particle 0.02 mm diameter is 100 times greater than a spherical particle of 0.002 mm in diameter. The difference in surface area contributes to the differences in adhesion and cohesion of the texture groups.

Sands allow faster permeability of water than clays because of their large grain size. The disadvantages of sands are that they hold very little water that would be available to plants and have no ability to hold onto plant nutrients in the way that clays do.

Loam soils contain sand, silt and clay in such proportions that stickiness and non-adhesiveness are in balance - the soils are mouldable but not sticky. Loams are the easiest soils to cultivate.

Clays can absorb and hold onto large amounts of water because of their sheet structure and large surface area. Most clays also swell and shrink as they wet and dry and are therefore important in generating cracks in soil through which roots can easily pass. When clays are wet and swollen, soil water cannot drain freely. The large surface area of clays means that they play an important role in soil fertility by adsorbing nutrients and releasing them into the soil solution for plant uptake.

Measuring soil texture

Field or hand texturing is conducted by moistening and kneading a small handful of soil into a ball slightly larger than the size of a golf ball (bolus) and pressing it out to form a ribbon between the thumb and forefinger (see photos above). The behaviour of the soil during bolus formation, and the length of ribbon produced before it breaks, characterises the field texture.

Take a sample of soil and remove the gravel and roots. The sample should be sufficient to fit comfortably into the palm of your hand. Moisten the soil with a little water and knead it into a bolus for 1–2 minutes making sure it is kept moist to wet. Place the bolus between your thumb and forefinger and slide your thumb across the soil (shearing) to extrude a ribbon. Try to make a thin continuous ribbon about 2 mm thick and 1 cm wide. Measure and record the length of the ribbon produced using a rule. Soils with high clay content are further categorised by moulding the bolus into rods. If the rods fracture the soil is assigned a texture grade lighter than a medium clay. A breakdown of field texturing categories is given in Table 1.

Table 1. Field characteristic of different soil textures (adapted from McDonald et al. 1998).

Soil texture	Ribbon length	How the soil feels/behaves	Approx. clay content
Sand	nil	Coherence nil to very slight, cannot be moulded; sand grains adhere to fingers.	< 5%
Loamy sand	5 mm	Slight coherence; sand grains of medium size; can be sheared between thumb and forefinger.	5–10%
Clayey sand	5–15 mm	Slight coherence, sticky when wet, many sand grains stick to fingers, discolours fingers with clay.	5–10%
Sandy loam	15–25 mm	Coherent bolus but very sandy to the touch; dominant sand grains are of medium size and readily visible.	10–20%
Loam	about 25 mm	Loams can form a thick ribbon. Soil ball is easy to manipulate and has smooth spongy feel with no obvious sandiness. May be greasy to touch if much organic matter present.	about 25%
Silt loam	about 25 mm	Coherent bolus; very smooth to silky when manipulated.	About 25%
Sandy clay loam	25–40 mm	Strongly coherent bolus, sandy to touch; medium sand grains visible in a finer matrix.	20–30%
Clay loam	40–50 mm	Strongly coherent and plastic bolus, smooth to manipulate and slightly sticky.	30–35%
Silty clay loam	40-50 mm	Coherent smooth bolus; plastic and often silky to the touch.	30-35%
Sandy clay	50–75 mm	Plastic sticky bolus, fine to medium sand grains can be seen and felt.	35–40%
Light clay	50–75 mm	Plastic behaviour evident; smooth feel; easily worked, moulded and rolled into rod. Rod forms a ring without cracking.	35–40 %
Light medium clay	75–85 mm	Plastic bolus; smooth to touch; slight to moderate resistance to ribbon shearing.	40–45%
Medium clay	> 75 mm	Smooth plastic bolus; handles like plasticine; can be moulded into rods without cracking; resistant to shearing and sticks to thumb and forefinger.	45–55%
Heavy clay	> 75 mm	Smooth, very plastic bolus; firm resistance to shearing; will mould into rods. Handles like stiff plasticine. Very sticky and strongly coherent. Rods will form a ring without cracking.	over 50%

Changing soil texture

The texture of soil is considered to be a stable property. That is, changing the texture of your soil is possible but involves considerable mechanical and financial input. One example is clay delving, where clay from the subsoil is mixed with sandy surface soil. For most land managers, changing the texture of the soil is not a viable option for soil management. Texture often changes naturally with depth down the soil profile and it is important to know how the texture changes. Many of our soils have loamy surface soils and heavy clay subsoils. This arrangement controls the movement of water through the profile as the clay restricts downward drainage and can result in waterlogging of the surface soil, even though the subsoil may not be saturated.

Reference

McDonald RC, Isbell RF, Speight JG, Walker J, Hopkins MS (1998) 'Australian Soil and Land Survey Field Handbook' (Australian Collaborative Land Evaluation program: Canberra).

Wealth from Water

Local call on 1300 368 550

email wfwp@dpipwe.tas.gov.au

www.dpipwe.tas.gov.au/wealthfromwater

Produced by Dr Bill Cotching, TIAR

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